

The Claims

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. (Previously Presented) In an industrial equipment network for interconnecting a plurality of devices, apparatus for permitting an associated SCADA system to be self-configuring, comprises:

a plurality of controllers dedicated to each one of said plurality of devices, respectively, for providing each with control and data functions for interacting with other of the devices in the equipment network, and other systems, wherein each one of said plurality of devices includes device configuration means for creating or updating device configuration data, the device configuration data including description of the device and representation of interconnection and interaction of the device with other ones of said plurality of devices;

a computer network;

means connected between said computer network and said plurality of controllers, respectively, for transferring data and/or control signals between individual ones of said plurality of controllers and said computer network at given times; and

auto-discovery means for permitting said SCADA system to both self-configure itself relative to devices in said industrial equipment network, and to be updated relative to changes in the configuration of said industrial equipment, and associated devices or equipment therein, including discovering new or changed devices via communication of the device configuration data over said computer network.

2. (Original) The apparatus of claim 1, wherein said plurality of controllers are each provided by a programmable logic controller (PLC).

3. (Original) The apparatus of claim 1, wherein said transfer means is selected from the group consisting of a router, and switch.

4. (Original) The apparatus of claim 1, wherein said computer network consists of a local area network (LAN).

5. (Previously Presented) The apparatus of claim 1, wherein said auto-discovery means includes:

broadcast means for operating a controller of a given device, that has either changed its configuration or is new to said industrial equipment network, to broadcast over said computer network an auto-discovery protocol; and

server means included in said SCADA system responsive to an auto-discovery protocol from said given device, for requesting said controller of said given device for the device configuration data to permit said SCADA system to update its configuration for the given device itself and within the industrial equipment network.

6. (Previously Presented) The apparatus of claim 1, wherein said auto-discovery means includes:

server means included in said SCADA system and connected to said computer network, for in a first mode of operation periodically polling respective controllers of all of said plurality of devices in said industrial equipment network for any respective changes in configuration and identification of new ones of said plurality of devices, and in a second mode of operation individually requesting each responding one of said plurality of devices for the device configuration data to permit said SCADA system to update its configuration information.

7. (Previously Presented) A method for permitting a Supervisory Control and Data Acquisition system (SCADA) to automatically diagram the interconnection and interaction, and changes thereto, between a plurality of

pieces of industrial equipment and/or a plurality of devices that may be connected to one another and to a data network, said method comprising:

configuring said plurality of pieces of industrial equipment and/or devices using a configuration tool included in each of said plurality of pieces of industrial equipment and/or devices, the configuration tool creating or updating device configuration data including description of the piece of industrial equipment and/or device and representation of the interconnection and interaction thereof with other ones of said plurality of pieces of industrial equipment and/or devices;

establishing a network over which said plurality of pieces of industrial equipment and/or devices can selectively communicate with one another and with a SCADA system;

connecting different ones of said plurality of pieces of industrial equipment and/or devices each to either a common controller, or each to individual dedicated controllers, respectively, or each to a plurality of controllers, or some combination thereof; and

programming each controller for controlling and identifying its associated piece of industrial equipment and or device, and for sending the device configuration data both to the other ones of said plurality of pieces of industrial equipment and/or devices, and to said SCADA system over said data network.

8. (Previously Presented) The method of claim 7, further including the steps of:

assigning a unique IP address to each one of said plurality of pieces of industrial equipment and/or devices upon their request as they are connected to the network;

broadcasting onto the data network an auto-discovery protocol including the associated IP address from each piece of equipment or device when it is added to the network, or thereafter when a change is made to its interconnections and interaction with other of said plurality of pieces of equipment, and/or devices;

acknowledging via a server of said SCADA system the receipt of an auto-discovery request;

transferring to said server the device configuration data of the associated piece of equipment or device, to permit said SCADA system to configure monitoring;

operating said SCADA system to automatically monitor either by polling or receiving broadcasts from said piece of equipment or device; and

programming said SCADA system to automatically update and include the associated piece of equipment or device in a diagram identifying and showing each, and their interaction with other ones of said plurality of pieces of equipment and/or devices.

9. (Previously Presented) The method of claim 7, wherein an extensible mark-up language (XML) is used to represent the device configuration data.

10. (Previously Presented) The method of claim 7, further including the steps of:

assigning a unique IP address to each one of said plurality of pieces of industrial equipment and/or devices upon their request as they are connected to the network;

programming a server in said SCADA system to periodically poll said plurality of pieces of industrial equipment and/or devices;

operating a controller of each polled device or piece of industrial equipment to respond to a discovery request from said server by providing the device configuration data thereof; and

operating said server to use the device configuration data to configure monitoring of the associated device or piece of industrial equipment, whereafter device or equipment monitoring begins.

11. (Canceled)

12. (Previously Presented) The method of claim 7, further including the steps of:

configuring each dedicated controller for having its associated device or piece of industrial equipment interconnect and interact with selected other ones of said plurality of pieces of industrial equipment and/or devices;

operating each controller for connecting its associated device or piece of equipment to said network;

operating each controller and a server in said SCADA system for providing auto-discovery by the latter of each device and/or piece of equipment;

operating each controller to respond to a request from said server to provide the device configuration data of the associated device and/or piece of equipment;

operating said server, in response to the device configuration data to initially establish and thereafter update a database and a user interface of said SCADA system; and

operating said server to begin monitoring the associated device.

13. (Canceled)

14. (Original) The method of claim 12, further including in said step of operating each controller and a server in said SCADA system for providing auto-discovery, the steps of:

measuring the time for said server to respond to a controller of a device or piece of equipment awaiting a reply, and

indicating a network fault, and interrupting further SCADA system processing for the associated device or piece of equipment, if no reply is received within a predetermined period of time.

15. (Original) The method of claim 7, further including the steps of:

configuring each dedicated controller for having its associated device or piece of industrial equipment interconnect and interact with selected other ones of said plurality of pieces of industrial equipment and/or devices;

operating each controller for connecting its associated device or piece of equipment to said network;

operating each controller to request a reply from a respective controller of each selected one of other of said plurality of devices and/or pieces of equipment;

operating each controller to wait for a reply; and

operating a requesting controller in response to a reply from another controller to provide the latter with data for updating a database of its associated device or piece of equipment with identification and interconnection data associated with the device or piece of equipment of the requesting controller.

16. (Original) The method of claim 15, wherein said step of operating each controller to wait for a reply further includes the steps of:

measuring the time from making a request for reply to the receipt of a reply; and

indicating a network fault and interrupting further processing if no reply is received within a predetermined period of time.

17. (Original) The method of claim 12, further including the steps of:

operating each controller to request a reply from a respective controller of each selected one of other of said plurality of devices and/or pieces of equipment;

operating each controller to wait for a reply; and

operating a requesting controller in response to a reply from another controller to provide the latter with data for updating a database of its associated device or piece of equipment with identification and interconnection data associated with the device or piece of equipment of the requesting controller.

18. (Original) The method of claim 17, wherein said step of operating each controller to request contact from a respective controller of each one of said plurality of devices and/or pieces of equipment, further includes the steps of:

measuring the time from making a request for reply to the receipt of a reply; and

indicating a network fault and interrupting further processing if no reply is received within a predetermined period of time.

19. (Previously Presented) The method of claim 12, wherein said step of operating each controller and a server in said SCADA system for providing auto-discovery by the latter of each device and/or piece of equipment, further includes the steps of:

assigning a unique IP address to each one of said plurality of pieces of industrial equipment and/or devices upon their request as they are connected to the network;

broadcasting onto the data network an auto-discovery protocol including the associated IP address from each piece of equipment or device when it is added to the network, or thereafter when a change is made to its interconnections and interaction with other of said plurality of pieces of equipment, and/or devices;

acknowledging via a server of said SCADA system the receipt of an auto-discovery request;

requesting via said server the device configuration data of the associated piece of equipment or device, to permit said SCADA system to configure monitoring;

operating said SCADA system to automatically monitor said piece of equipment or device; and

programming said SCADA system to automatically update and include the associated piece of equipment or device in a diagram identifying and showing each, and their interaction with other ones of said plurality of pieces of equipment and/or devices.

20. (Previously Presented) The method of claim 12, wherein said step of operating each controller and a server in said SCADA system for providing auto-discovery by the latter of each device and/or piece of equipment, further includes the steps of:

assigning a unique IP address to each one of said plurality of pieces of

industrial equipment and/or devices upon their request as they are connected to the network;

programming a server in said SCADA system to periodically broadcast a discovery request poll to said plurality of pieces of industrial equipment and/or devices;

operating a controller of each polled device or piece of industrial equipment to respond to a discovery request from said server by providing the device configuration data thereof; and

operating said server to use the device configuration data to configure monitoring of the associated device or piece of industrial equipment, whereafter device or equipment monitoring begins.

21. (Previously Presented) The apparatus of claim 1, wherein the device configuration means includes a configuration tool for allowing a user to enter operating parameters of the device, and creating a device-configuration file based on the operating parameters.

22. (Previously Presented) The apparatus of claim 21, wherein the device configuration file is organized as a hierarchy.

23. (Previously Presented) The apparatus of claim 1, wherein the plurality of controllers are configured such that the device configuration data, in its entirety, is communicated to said SCADA system while only relevant part of the device configuration data is communicated to other ones of said plurality of devices in the equipment network.